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(71) Applicant:
SEIKO EPSON CORPORATION
Shinjuku-ku, Tokyo 163-0811 (JP)

(72) Inventors:
- **Aruga, Kazuhisa**
  Suwa-shi, Nagano-ken 392-8502 (JP)
- **Mochizuki, Hidetake**
  Suwa-shi, Nagano-ken 392-8502 (JP)
- **Koakutsu, Naohiko**
  Suwa-shi, Nagano-ken 392-8502 (JP)
- **Fukano, Kazuko**
  Suwa-shi, Nagano-ken 392-8502 (JP)
- **Teradaira, Mitsuaki**
  Suwa-shi, Nagano-ken 392-8502 (JP)

(74) Representative:
Hoffmann, Eckart, Dipl.-Ing.
Patentanwalt,
Bahnhofstrasse 103
82166 Gräfelfing (DE)

(54) Printing apparatus, method of controlling it and storage medium

(57) A printing apparatus adapted to be connected to a host device and to receive control commands and print data from the host device comprises first operation counting means (2-5) for counting a first value indicative of the number of times of a certain operation of the printing apparatus (1) and for storing the first value in a non-volatile manner as first operating history information; second operation counting means (2-5) for counting a second value indicative of the number of times of said certain operation of the printing apparatus (1) and for storing the second value in a non-volatile manner as second operating history information; and count value changing means responsive to a predetermined input for changing said first value while not changing said second value. The printing apparatus is thus capable of obtaining and storing both total operation counts (cumulative counts since the printer was first used) and differential or incremental operation counts for individual consumable and nonconsumable parts of a printing apparatus.

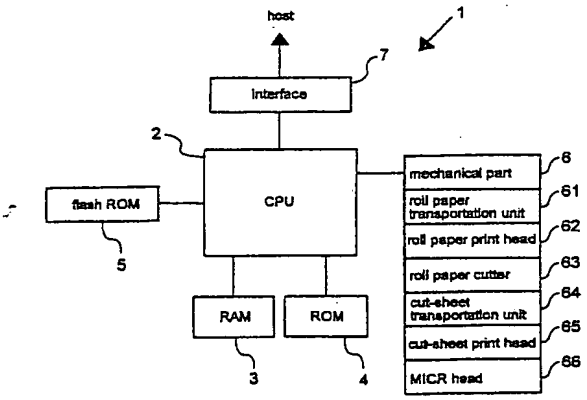

FIG. 1

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Fig. 6 is a sample of a print-out in a test print mode of the printing apparatus of Fig. 1.

[0014] A preferred embodiment of a printing apparatus according to the present invention (simply referred to as "printer" hereinafter) is described below with reference to the accompanying figures.

[0015] As shown in Fig. 1, printer 1 comprises a central processing unit (CPU) 2 for overall control of the printer 1; random access memory (RAM) 3 that is used as primary working memory; read-only memory (ROM) 4 for storing control data, an application program, and related information; flash ROM 5 for storing information relating to the operating status of the printer 1; a mechanical part 6 comprising the mechanisms for printing on paper using a print head; and an interface 7 for connecting the printer 1 to a host device (not shown).

[0016] Printer 1 receives print data, control commands, and other information from the host device via interface 7. Received data is buffered in RAM 3, which also provides for temporary storage. The interface 7 can also be used to reset the CPU 2 by means of a signal line connected to the host device.

[0017] When CPU 2 initializes in response to the power to printer 1 being turned on or a reset signal sent from the host device (referred to below as simply "initialization"), CPU 2 reads a program from ROM 4, and executes the program to control printer 1. CPU 2 also interprets data received through interface 7 and buffered in RAM 3. If the buffered data is a control command for printing, CPU 2 accesses font data in ROM 4, and develops in RAM 3 a print image corresponding to previously received print data. CPU 2 then controls driving of mechanical part 6 to print the print image.

[0018] In a printer 1 according to this preferred embodiment, mechanical part 6 comprises mechanisms for printing on roll paper, that is, a roll paper transportation unit 61, a roll paper print head 62, and a roll paper cutter 63; and mechanisms for printing on cut-sheet forms, that is, a cut-sheet transportation unit 64, and a cut-sheet print head 65. In this embodiment, mechanical part 6 further comprises a magnetic ink character reader (MICR) head 66.

[0019] CPU 2 further comprises an internal timer for issuing a timer interrupt at a constant interval. A time counter is realized by a program stored in ROM 4 and invoked by the timer interrupt so as to measure the operating time of printer 1.

[0020] Flash ROM 5 can be read and written by CPU 2, and forms a non-volatile memory, i.e., it keeps its content even when no power is supplied. During initialization of printer 1, CPU 2 reads printer operation count values stored as operating history information in flash ROM 5 and loads them into RAM 3. During the subsequent operation of the printer these count values in RAM 3 are incremented in accordance with the respective operations. In this way "counters" for counting the respective printer operations are implemented by software. The count values of these counters, i.e., the operating history information including the total operating time of the printer, are then written back to flash ROM 5 at a specific timing.

[0021] The time counter noted above measures the operating time of the printer 1 and is also used for controlling the saving of the count values from RAM 3 to flash ROM 5. The count values are periodically written to flash ROM 5 at a specific write period, which in this preferred embodiment is 2 minutes as measured by the time counter.

[0022] It should be noted that this write period is appropriately determined taking the life-time (number of write operations possible) of flash ROM 5 and other factors related to printer hardware into consideration. For example, this write period will depend on the printer's shutdown procedure, i.e., the procedure controlling what happens when the printer's power switch is turned off, namely whether the power supply is immediately cut-off when the power switch is turned off, or a software procedure for storing essential data is executed before the power supply is cut off. In the former case, data will be lost if the power switch is turned off before the data has been stored, and more frequent saving is therefore desirable. As a result, the write period is set to a short interval, for example, 2 minutes. In the latter case, however, data can be saved even after the power switch is turned off. The write period can therefore be set to a longer interval, such as 1 hour.

[0023] Exemplary printer operations to be counted and stored as operating history information in flash ROM 5 are shown below. Note that each printer operation is assigned a respective identification code, which is used in an exemplary control command further described below.

Cut-sheet form line feeds
A-counter = 10
B-counter = 138
Cut-sheet form printed characters
A-counter = 11
B-counter = 139
Roll paper line feeds
A-counter = 20
B-counter = 148
Roll paper print head, power on
A-counter = 21
B-counter = 149
Roll paper cutter drive operations
A-counter = 50
B-counter = 178
MICR read operations
A-counter = 60
B-counter = 188
Product operating hours
A-counter = 70
B-counter = 198

command *GS g 1* can be used to set the counter to an arbitrary value. If the specified counter ID does not match that of any A-counter, no counter is changed. This prevents the count values of B-counters from being changed.

(3) The change counter process is not executed if a print mode has been selected for printing by a print command after print data received from the host device have been developed in memory and stored in a one-line print buffer, and unprinted data remain in the one-line print buffer. This prevents loss of unprinted data resulting from printer operations being stopped based on a memory error in the above change counter process, and thus protects unprinted print data.

(4) In another print mode, the so called page mode, in which print data received from the host device is developed and then stored in a designated area of a page buffer having a length of multiple lines, the change counter process is also prohibited when the area of the page buffer has been designated by a predetermined control command from the host device even if no print data is received nor developed by the printer. Thus, the setting of the area which is considered as a part of print information can also be protected.

(5) If a write error occurs during writing, the error is announced using an LED or a buzzer, and/or by sending an error status signal or changing the state of the signal line to the host device via the interface 7. The operator or host device can thus be informed that the count value could not be changed normally as a result of an error occurring in the printer 1.

(6) Count values changed in RAM 3 are written to flash ROM 5 irrespective of whether the time counter indicates it is the normal flash ROM write timing. To prevent loss of any count value changed by the change counter command 40 as a result of CPU 2 being reset by a command from the host device before the changed count value is written to flash ROM 5 according to the normal flash ROM write timing, the flash ROM 5 is also written when the change counter command 40 is processed. It will also be obvious that the same result can be achieved by providing a separate flash ROM 5 write command, and using the flash ROM write command together with the change counter command 40.

[0034] A typical control command for reading a count value is shown in Fig. 5. This read counter command 50 comprises a command code part 51 and a parameter part 52. The command code part 51 comprises an extension 53 and function code 54, and the parameter part 52 comprises a function extension parameter 55 and a counter ID 56. The extension 53 is the ASCII control character "GS" for the hexadecimal character code "1D". The function code 54 is a code string for specifying the read counter function; two character codes are combined to specify the read function. The function extension parameter 55 specifies the read counter function key. The counter ID 56 identifies the counter to be read.

[0035] The CPU 2 performs the following operations in response to the read counter command 50.

(1) The key specified by the function extension parameter 55 is compared with a predetermined key; if the keys match, the specified count value is sent. If the keys do not match, sending is prohibited.

(2) If the counter ID 56 matches that of a counter, the corresponding counter value stored to RAM 3 is read. If the counter ID 56 does not match that of any counter, the send command is ignored.

(3) If a read error occurs during execution of the command, the error is announced using an LED or a buzzer, and/or by sending an error status signal or changing the state of the signal line to the host device via the interface 7. The operator or host device can thus be informed that the count value could not be sent as a result of an error occurring in the printer 1. (4) A header code or terminate code can be added to the transmitted data to enable the host device, for example, to easily recognize the beginning and end of the transmitted data.

The CPU 2 also executes the following process before transmitting a count value to the host device:

(5) Step 1: Convert the count value

Count values that can be used for determining the expiry of a component's service life include values that can be easily used (understood) directly, and values that are difficult to use directly. For easy-to-use count values, the data can be sent directly, i.e., in the form they are stored. Values that are difficult to use, however, typically need to be converted to an expression that can be more easily interpreted for service life determinations.

Consider, for example, the line feed count for cut-sheet forms. The drive power source for the cut-sheet transportation unit 64 is a stepping motor (not shown in the figures). The CPU 2 counts the number of steps performed by the stepping motor, and stores this simple step count. For the user, however, it is extremely difficult to grasp how much paper has been advanced using this step count.

The line feed distance of a printer 1 according to this preferred embodiment is 1/6 inch (ca. 4.2 mm), and the cut-sheet transportation unit 64 must

print data from the host device, said printing apparatus comprising:

operation counting means (2-5) for counting a value indicative of the number of times of a certain operation of the printing apparatus (1);
means responsive (2-5, 7) to a predetermined input for storing, in a non-volatile manner, the value counted up to the time of said input; and
history information output means (2-5) for determining, as first operating history information, the value counted up to the moment of determination, and, as second operating history information, the difference between the value counted up to the moment of determination and said stored value.

2. The apparatus of claim 1 comprising a plurality operation counting means (2-5), each for counting a respective value indicative of a certain operation of the printing apparatus which operation is a different one for each value.

3. A printing apparatus adapted to be connected to a host device and to receive control commands and print data from the host device, said printing apparatus comprising:

first operation counting means (2-5) for counting a first value indicative of the number of times of a certain operation of the printing apparatus (1) and for storing the first value in a non-volatile manner as first operating history information;
second operation counting means (2-5) for counting a second value indicative of the number of times of said certain operation of the printing apparatus (1) and for storing the second value in a non-volatile manner as second operating history information; and
count value changing means responsive to a predetermined input for changing said first value while not changing said second value.

4. A printing apparatus adapted to be connected to a host device and to receive control commands and print data from the host device, said printing apparatus comprising:

non-volatile storage means (5);
a pair of first and second operation counting means (2 3) for counting a pair of first and second values, respectively, indicative of the number of times of a certain operation of the printing apparatus (1), wherein said first and said second value are both indicative of the number of times of the same operation of the printing apparatus;
storing means (2) for storing said first and said second value counted by said first and said second operation counting means (2, 3) as first and second pieces of operating history information, respectively, in said non-volatile storage means (5);
initialization means (2) for initializing the printing apparatus, said initialization means including presetting means for presetting said first and second operation counting means (2, 3) to values corresponding to said first and second pieces of operating history information, respectively, and
count value changing means capable of changing only said first value.

5. The apparatus of claim 3 or 4 comprising a plurality of pairs of first and second operation counting means (2-5), each pair for counting first and second values indicative of a certain operation of the printing apparatus which operation is a different one for each pair.

6. The apparatus of claim 4 or 5, further comprising:

operating time measurement means (2, 3) for measuring the operating time of the printing apparatus (1); and
detection means for detecting whether the printing apparatus is performing a specific process;
wherein said storing means (2) is adapted to periodically store said operating history information in said non-volatile storage means (5) at time instants indicated by said operating time measurement means (2, 3), and responsive to said detection means to delay said storing relative to such time instant, if, at that time instant, the printing apparatus is performing said specific process.

7. The apparatus of claim 6, wherein said storing means is arranged such that said storing is delayed until either said specific process is no longer performed or a predetermined delay time has elapsed, whatever is earlier.

8. The apparatus of any one of claims 3 to 7, wherein said count value changing means is responsive to a first particular one (40) of said control commands.

9. The apparatus of any one of the preceding claims, further comprising:

transmission means (2, 7) responsive to a second particular one (50) of said control commands for reading operating history information and sending it to the host device.

said control commands, and

(k) in response to step (j) reading operating history information stored in step (b) and/or step (d) as and sending it to the host device.

22. The method of claim 21 wherein step (k) includes:

converting said read operating history information to an index allowing evaluation of whether or not the service life of a component involved in the operation whose number is represented by said operating history information has expired; and
sending operating history information in the form of said index to the host device.

23. The method of claim 21 or 22, further comprising the step of:

(l) coding the operating history information or the index, respectively, by hexadecimal to decimal conversion and sending the coded information to the host device.

24. The method of any one of claims 21 to 23, further comprising the step of:

(m) displaying the operating history information or the index, respectively.

25. The method of claim 24, wherein step (m) comprises printing said operating history information or index, respectively.

26. The method of any one of claims 18 to 25, wherein steps (b) and (d) are performed in responsive to a third particular one of said control commands independent of said time measurement.

27. A machine readable storage medium carrying a program for implementing the method as defined in any one of claims 15 to 26.

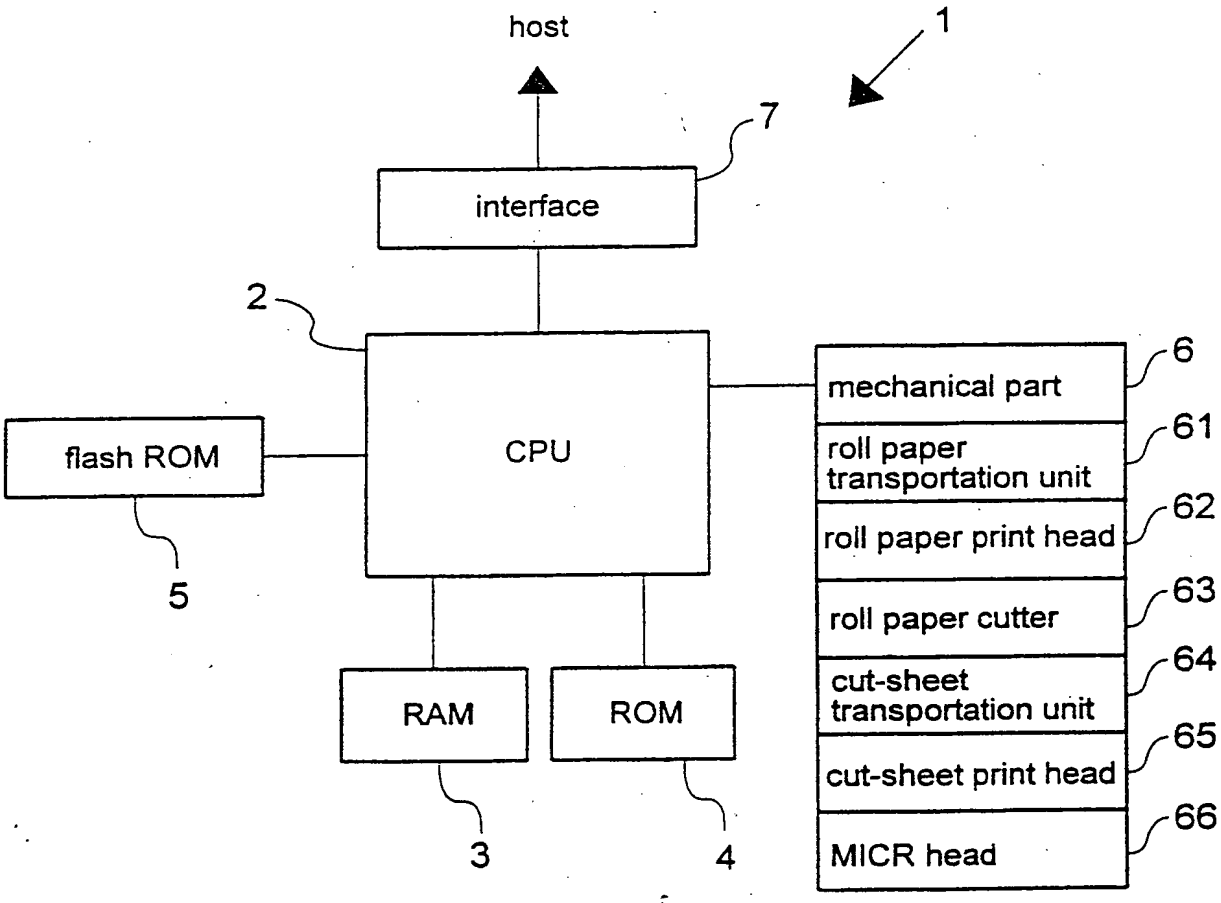
host
1
7
interface
2
CPU
flash ROM
5
RAM
ROM
3
4
mechanical part
6
roll paper transportation unit
61
roll paper print head
62
roll paper cutter
63
cut-sheet transportation unit
64
cut-sheet print head
65
MICR head
66

FIG. 1

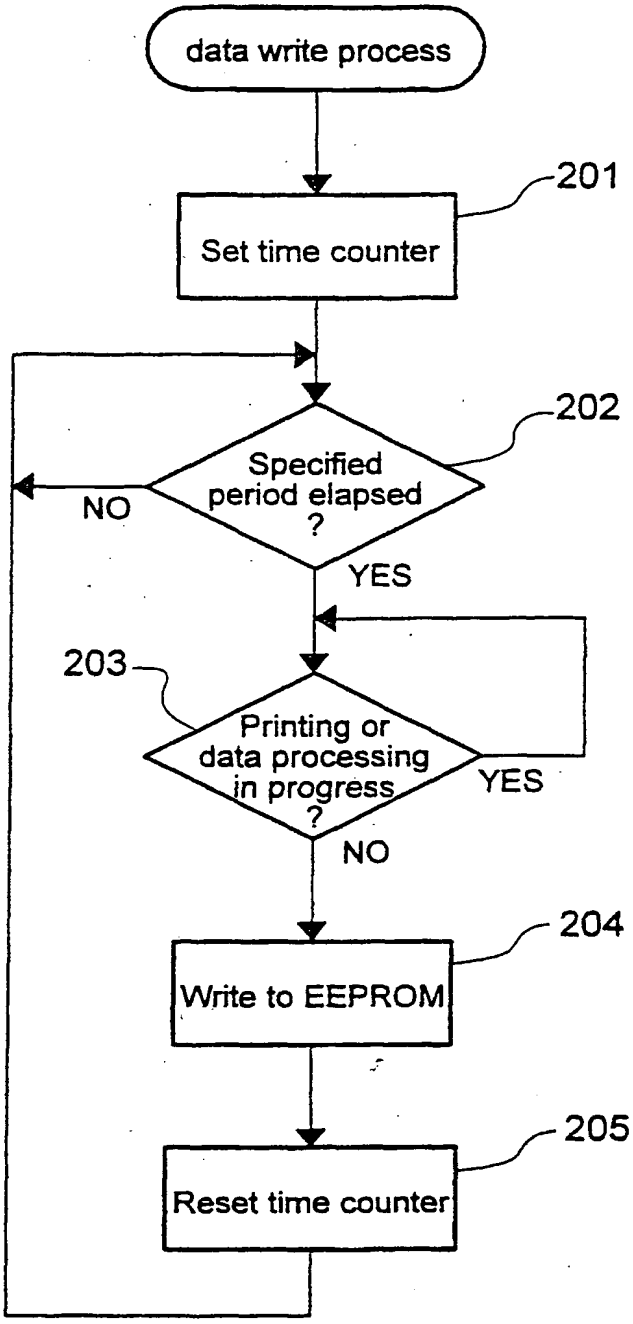
data write process
201
Set time counter
202
Specified period elapsed ?
NO
YES
203
Printing or data processing in progress ?
YES
NO
204
Write to EEPROM
205
Reset time counter

FIG. 2

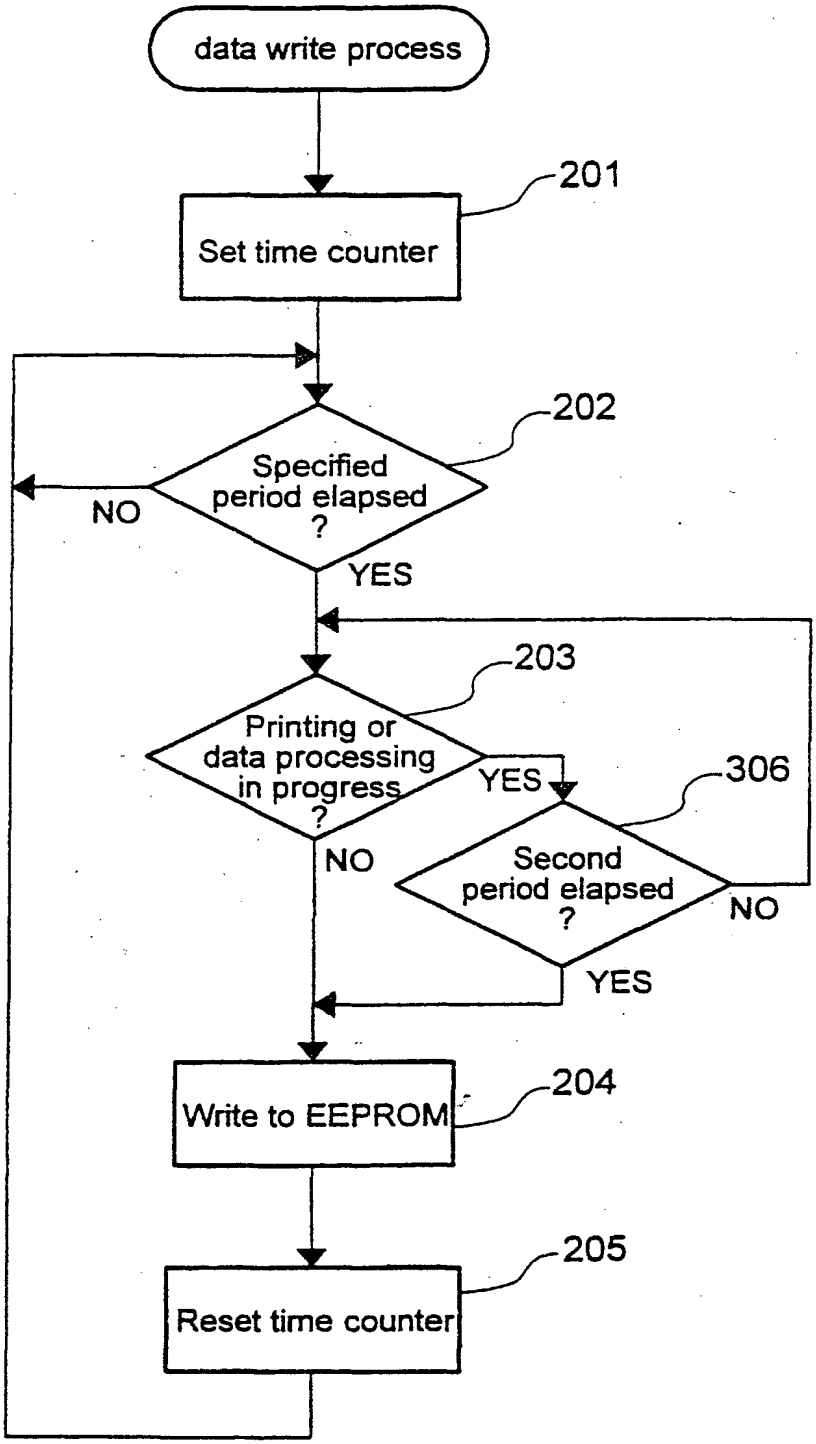
data write process
201
Set time counter
202
Specified period elapsed ?
NO
YES
203
Printing or data processing in progress ?
YES
306
Second period elapsed ?
NO
YES
NO
204
Write to EEPROM
205
Reset time counter

FIG. 3

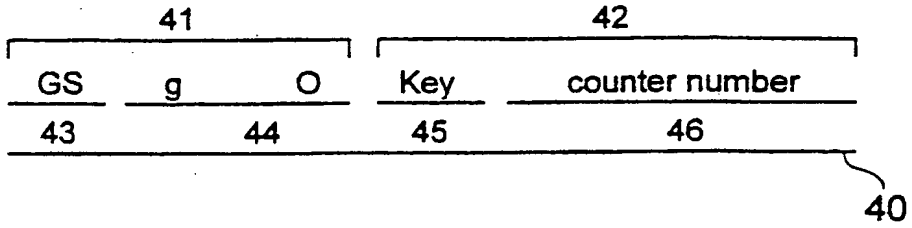
41
42
GS
g
O
Key
counter number
43
44
45
46
40

FIG. 4

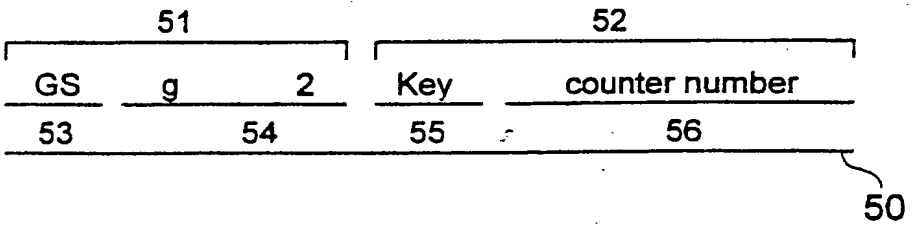
51
52
GS
g
2
Key
counter number
53
54
55
56
50

FIG. 5

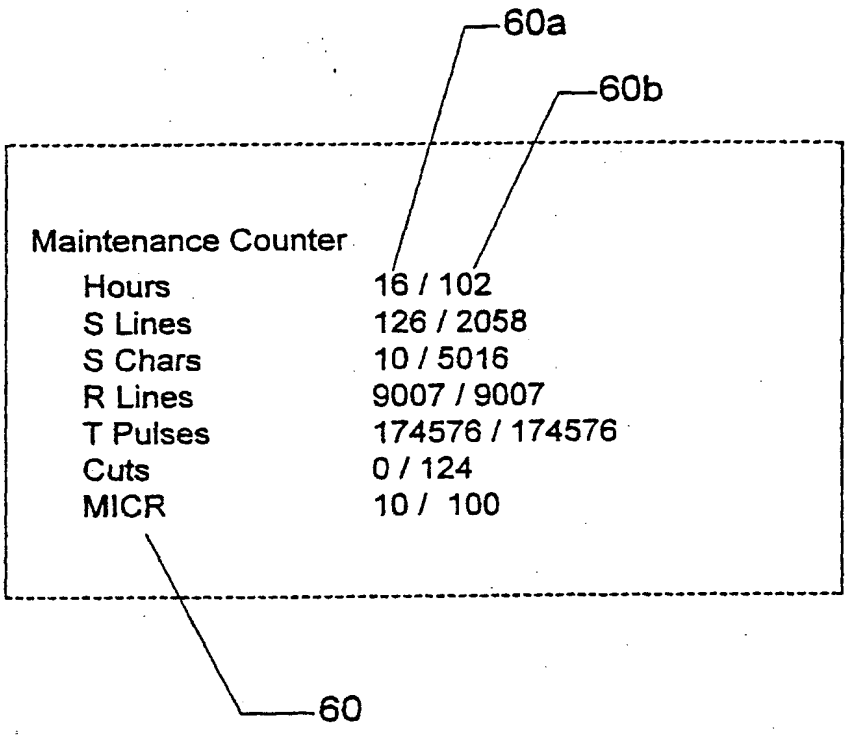
60a
60b
Maintenance Counter
Hours 16 / 102
S Lines 126 / 2058
S Chars 10 / 5016
R Lines 9007 / 9007
T Pulses 174576 / 174576
Cuts 0 / 124
MICR 10 / 100
60

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 98 12 2168

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TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B41J
G03G
H04N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 March 1999	Adam, E

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